temperature alteration device 436 is a cooling unit, then layer 438 is a conductor having high performance thermal conducting properties to conduct the heat away from the optical components. A controller (not shown) is also provided to control the heating and cooling provided by the temperature alteration device 436. Layer 440 is provided to encapsulate the thermally conductive layer 432 (with the optical components mounted thereon), the temperature alteration device 436, the controller, and the heat spreader 438, and may either be an insulator or a good thermal conductor depending upon whether the temperature alteration device 436 is a heater or a cooling unit, respectively. An external casing (or outer package) 442 can also be provided to encapsulate the remaining layers. For more details regarding exemplary Fiber Bragg component containers, interested readers are referred to co-pending, commonly assigned, U.S. Patent Application Serial No. 09/969,030, entitled "Packaging Structure for Optical Components", to Lowell Seal et al., filed on October 3, 2001, the disclosure of which is incorporated here by reference.

[00113] An exemplary line assembly printed circuit board (PCB) 406 is illustrated in Figure 16. Therein, it can be seen that the PCB 406 includes first and second PCBs 450 and 452 sandwiching a core board 454. The PCB 452 has openings formed therein which permit the lasers 314 to be directly mounted to the core board 454, which is tapped for this purpose as seen in area 456. Core board 454 can, for example, be formed of 3-6 mm of copper and provides a mechanism for conducting the heat generated by the lasers 314 out to the pressure vessel 200. Although only four lasers 314 and sixteen areas 456 are illustrated as populating the PCB 452, those skilled in the art will appreciate that more or fewer lasers can be provided for therein depending upon the Raman pump design considerations described above. A hybrid signal connector 458 is also provided for conveying power and command signals to the circuitry provided thereon.

[00114] Referring again to the line assembly 400, an exemplary optical fiber packing and containment container structure which can be used, for example, to hold the pump combiner assemblies 410, signal path component assemblies 414 and 4x4 coupler component assemblies 416, is illustrated in Figure 17(a). This container enables excess optical fiber to be wound and stored in a thin structure which allows for multiple entry

radiation source 310 (or two if bidirectional pumping is employed), one pump radiation combiner 312, a portion of the 4x4 coupler 318 (or portions of two 4x4 couplers with forward pumping), one set of signal path components, e.g, pump signal combiner 322, gain shape filter 330 and isolators 332, 334, and associated drive, power, monitoring and control circuitry.

[00109] According to a first exemplary embodiment, each line assembly 400 is fabricated as a rectangular frame 403 having a number of component containing structures mounted thereon, as well as electrical and optical interconnects, as seen in Figure 14. Initially an overview of the component containing structures in each line assembly will be provided, followed by more detailed information regarding each. Beginning with the top side 401, the line assembly 400 includes fiber bragg grating (FBG) containing assemblies 404, which may optionally have heating units associated therewith. These FBG assemblies 404 are used to contain the devices which act as wavelength lockers for each pump laser 314 as described above. The line assembly 400 also includes a printed circuit board 406 on which the pump lasers 314 are mounted and which carries the laser driver circuitry, as well as monitoring and control circuitry for the pump lasers. Each line assembly 400 further includes space for a power supply (not shown) to power the pump lasers 314 and other circuitry. One power supply 408 can be shared among the four line assemblies 400 in each line quad, or multiple power supplies (e.g., one on each line assembly) can be provided for redundancy.

[00110] Pump combiner assemblies 410 contain the pump beam combiner components and pump wavelength combiner components associated with pump radiation combiners 312. Both the top side 401 and the bottom side 402 of a line assembly can include spaces 412 for winding and excess fiber associated with optical component interconnects. These spaces can be oval in shape to accommodate a "figure eight" winding pattern at the minimum fiber bend diameter. Moreover, the shape and size of the spaces 412 can be determined based upon the manufacturing technique selected for winding the excess fiber, e.g., a manual or automated process. One example of an automated tool for winding excess fiber is described in co-pending, commonly assigned U.S. Patent Application Serial No. 09/927,440, entitled "Automated Fiber Winding Device", to Brent Pohl, filed on August 13, 2001, the disclosure of which is

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mechanism to secure all four line assemblies together. As seen in Figure 22, fiber ways 550 provide guides for routing optical fibers between line pair assemblies. Also seen in Figure 22 are posts 552 which provide electrical connections via solder, crimp or screw connections for power cables 554 to provide DC electrical power to the line quad assembly 514.

[00122] Figure 23 shows an exemplary technique for provisioning a repeater 16 with four line quad assemblies 514 into the inner frame structure 203 of the pressure vessel 200. Those skilled in the art will appreciate that one, two, three or four line quad assemblies may be mounted therein, depending upon how many optical fiber pairs are being supported in the optical communication system. Various mechanisms can be used to secure the line quad assemblies 514 therein. According to one exemplary embodiment of the present invention, the line assemblies 400 each have a dovetail groove 560 formed therein as shown in Figure 24. For the two outer line assemblies in each line quad assembly, e.g., 562 and 564, the dovetail groove 560 is used to secure the line quad assembly to the inner frame 203. For example, the dovetail groove in line assembly 562 can be slid into a mating engagement with abutment 570 in the inner frame 203. This engagement can be secured using, for example, a spring or a wedgelock 572 positioned within the dovetail groove of line assembly 564. The spring or wedgelock device 572 presses against the inner frame 203 and the dovetail groove of line assembly 564 using, e.g., 650 lbs of force, to lock its line quad assembly in place. Additional details regarding exemplary dovetail grooves and wedgelock devices which can be used in conjunction with high power repeaters according to the present invention can be found in commonly assigned, co-pending U.S. Patent Application Serial No. 09/949,933, entitled "Use of Dovetail Slides and Wedge Locking Devices for Mounting", to Lowell Seal, filed on September 12, 2001, and co-pending U.S. Patent Application Serial No. 09/948,674, entitled "Integrated Wedge Lock and Elastic Member", to Bob Adams et al., filed on September 10, 2001, the disclosures of which are incorporated here by reference.

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[00123] Those skilled in the art will appreciate that the foregoing exemplary embodiments provide ground breaking new designs in the area of repeater technology for underwater optical communication systems. The foregoing techniques enable high